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(54) IMPROVEMENTS IN OR RELATING TO TEMPERATURE CONTROLLED CABINETS

(71) I, CHARLES NEVILLE HILLIER, a British subject of 70 Drax Avenue, Wimbledon, London, S.W.20, do hereby declare the invention for which I pray that a patent may be granted to me, and the method by which it is to be performed, to be particularly described in and by the following statement:—

This invention relates to temperature controlled cabinets used for refrigeration and incubation. The problem found in some known so-called refrigerated incubators has been the load imposed upon the compressor when required to bring the temperature of the interior of the cabinet down from the region of say 40°C to say −10°C. It has been found that due to the high back pressure of the refrigerant at high temperatures, many normally available compressors either fail to operate or start with difficulty.

The object of the present invention is to provide a temperature controlled cabinet in which such compressor starting and running problems are overcome without the necessity of incorporating compressor with special characteristics, and in which, an improved temperature control and distribution becomes possible.

According to the present invention, a temperature controlled cabinet comprises a first chamber, a heating element disposed within said chamber, a second chamber disposed within said first chamber and in communication therewith, cooling means within said second chamber for providing therein a reservoir of cold air, first circulating means within said first chamber for circulating heated air within the first chamber, second circulating means within said second chamber for circulating the air in said first and second chambers through both said first and second chambers, and switch means for switching on said heating element and said first circulating means to effect heating of said first chamber and for switching on said second circulating means and said heating element off to effect cooling of said first chamber.

By providing apparatus according to the invention, the object is achieved without the need to isolate completely the cold reservoir. In this manner, the cost of production is substantially reduced.

A constructional form of the invention will now be described by way of example with reference to the accompanying drawings, in which:—

Figure 1 is a sectional side view, partly diagrammatic, of a cabinet,

Figure 2 is a sectional plan view, also partly diagrammatic, taken along the line A-A in Figure 1, and

Figure 3 shows a schematic diagram of an electric circuit comprising the cold air circulating fan and a heater.

In Figures 1 and 2 there is shown a cabinet body of which the outer casing 10 is shaped in accordance with a conventional incubator or temperature controlled cabinet. The casing is provided with a lining 11 spaced from the sides, top and bottom, and rear walls, the spaces 12 between being filled with a suitable thermally insulating material such as polyisocyanate foam. The cabinet has the usual thermally insulated hinged door 13.

Within the cabinet is disposed a conventional refrigerator evaporator 14 which in the present example is formed from shaped sheets enclosing a network of ducts for circulating the refrigerant. The refrigeration recirculatory system including condensor and compressor is not shown since this is conventional equipment.

The evaporator 14 is substantially isolated from the main volume of the cabinet space by means of a box-like structure (which I term a cold chamber) having a base 24 and front and rear walls 15, 16 extending over the entire width of the cabinet interior and

forming sills which are spaced from the top of the lining 11 by a suitable distance to permit the passage of air. A partition wall 17 positioned parallel to the front and rear walls 15, 16 extends from the bottom 24 of the cold chamber to the lining 11 and is provided with a fan 18. There is no necessity to insulate the cold box, but this may be done.

Arranged parallel to the rear wall of the lining 11 and spaced therefrom there is a partition 19 having a fan 20 centrally mounted therein. Behind the partition are located heating elements 21 which may be attached to the lining 11. The partition is spaced at its upper and lower edges respectively, from the bottom 24 of the cold chamber and the bottom wall of the lining 11 to permit flow of air from behind the partition, where the air can be heated, to the main volume of the cabinet space.

The partition 19 extends almost entirely over the width of the cabinet interior except at the side edges of the partition which are spaced from the lining to form vertical slits 22 at each side.

These slits communicate with channels 23 formed at the corners of the cabinet interior, there being no connection between the channels 23 and the space at the rear of the partition 19. The channels at their upper ends are in communication with the space to the rear of the wall 16 of the cold chamber.

Although not limited to such use, the cabinet will be described in cyclic operation in which the cabinet is maintained alternatively at steady high and low temperatures.

In operation the cold chamber serves as a reservoir for cold air which is substantially wholly retained and does not flow over the sill 16 until the fan 18 is driven. Accordingly, if for example the major volume of the cabinet containing various samples under test is at a temperature 37°C (blood temperature) or even up to 45°C, and the heaters 21 are switched off to initiate the cooling portion of the cycle, the cold air fan 18 starts instantaneously and, with the evaporator of course being at a low temperature, cooling of the cabinet air commences immediately by cold air flowing over the sill 16 and down through the corner channels 23 to the slits 22. The air is directed by the slits along the sides of the lining and thereby does not impinge on samples loaded in the cabinet. This cold air mixes with the warmer air being circulated by the fan 20 which remains in a driven state throughout the whole cycle. A portion of the mixed warm and cold air passes up and over the front wall 15 back into the cold chamber and recirculates until the temperature in the main part of the refrigerator space is reduced to the desired level. When this is reached a thermostat effects the switching on and off of the fan 18 and the contrary switching of the heaters to maintain the desired temperature level in the cabinet.

Figure 3 shows a schematic diagram including a clock 30 which times the temperature cycling in the cabinet, thermostats 31, 32 which can be set to control at different temperatures as and when selected by the clock 30. A relay 33 effects the switching of the fan 18 and the heater 21, under control of the thermostats. The clock determines which of the two thermostats will control the temperature of the cabinet.

Alternatively, if it is desired to operate the cabinet at substantially room temperature or above, the temperature control may be achieved entirely by thermostatic switching of the heaters alone.

By means of the present construction therefore the reserve of cold air facilitates rapid start up of the compressor, and prevents overload cut out of the pump due to excessive demand upon the evaporator. Furthermore, the construction is such that the air is evenly circulated throughout the cabinet space, a gradient across the chamber of ±0.5°C being achieved at any temperature level within the operating range.

WHAT I CLAIM IS:—

1. A temperature controlled cabinet comprising a first chamber, a heating element disposed within said chamber, a second chamber disposed within said first chamber and in communication therewith, cooling means within said second chamber for providing therein a reservoir of cold air, first circulating means within said first chamber for circulating heated air within the first chamber, second circulating means within said second chamber for circulating the air in said first and second chambers through both said first and second chambers, and switch means for switching on said heating elements and said first circulating means to effect heating of said first chamber and for switching on said second circulating means and said heating element off to effect cooling of said first chamber.

2. A cabinet as claimed in Claim 1, wherein said second chamber comprises a box-like structure which is located in an upper portion of the first chamber, said structure having a wall or walls spaced from the top of said first chamber sufficient to permit passage of air between the interior of said second chamber and the remainder of said first chamber.

3. A cabinet as claimed in Claim 2, wherein said structure comprises a base member and front and rear walls extending over the entire width of the first chamber, said walls forming sills over which the air may flow.

4. A cabinet as claimed in Claim 3, wherein between said front wall and said

cooling means is provided a first partition wall which contains said second circulating means in the form of a fan impeller.

5. A cabinet as claimed in Claim 3 or 4, wherein the box-like structure communicates with the first chamber via the space above the rear wall thereof and channels formed at the rear vertical corners of the first chamber.

6. A cabinet as claimed in Claim 5, wherein the channels are formed with longitudinal apertures which allow air to pass forward along the side walls of the first chamber.

7. A cabinet as claimed in any one of the preceding claims, wherein parallel to the rear wall of the first chamber there is arranged a second partition having said first circulating means in the form of a second fan impeller centrally mounted therein.

8. A cabinet as claimed in Claim 7, wherein the second partition is spaced from the bottom and sides of said first chamber and the underside of the second chamber whereby air can flow from the rear of the partition forwardly along the bottom of the first chamber and along the underside of said second chamber.

9. A cabinet as claimed in Claim 8, wherein the heating element is located between said second partition and said rear wall.

10. A cabinet as claimed in Claim 9, wherein said switch means comprises thermostat means for effecting the switching on and off of the first and second circulating means.

11. A cabinet substantially as described with reference to the accompanying drawings.

For the Applicants:
MATTHEWS, HADDAN & CO.,
Chartered Patent Agents,
Haddan House,
33 Elmsfield Road,
Bromley, Kent BR1 1SU.

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1434356 COMPLETE SPECIFICATION
2 SHEETS *This drawing is a reproduction of the Original on a reduced scale*
Sheet 1

FIG. 1

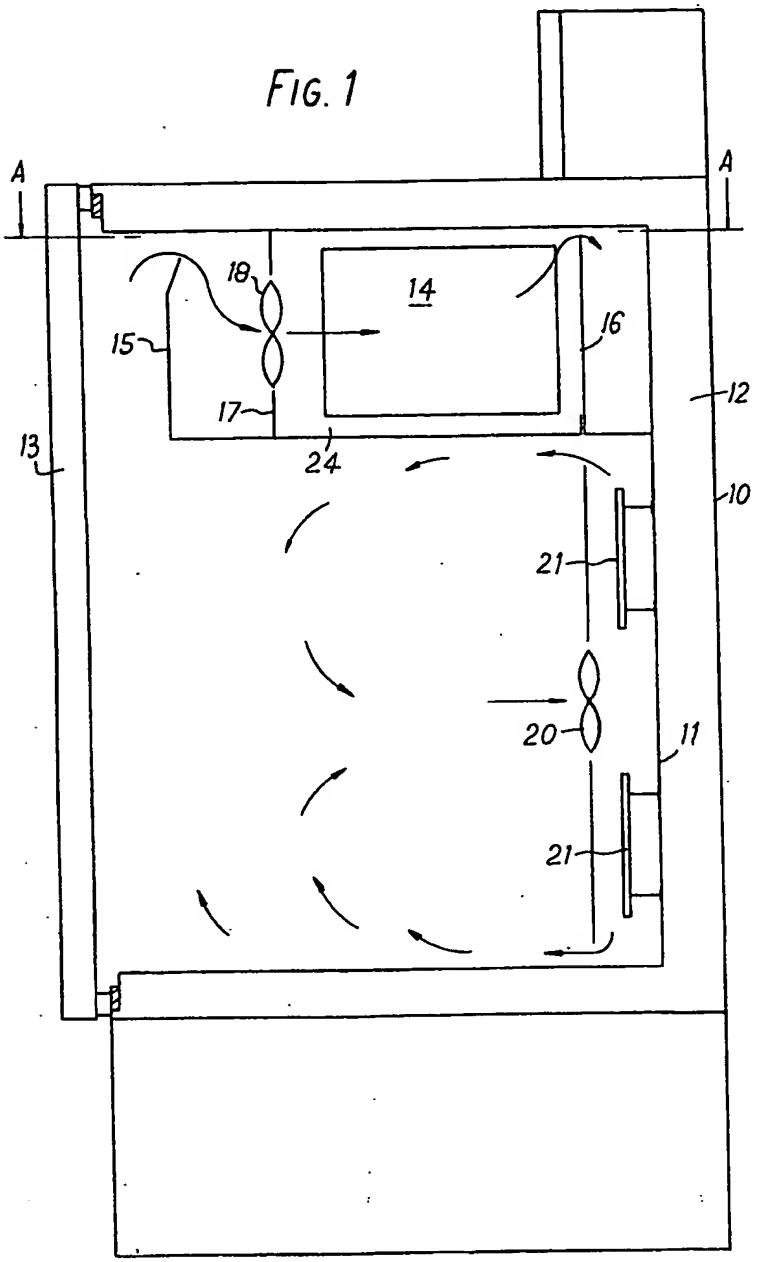

FIG. 2

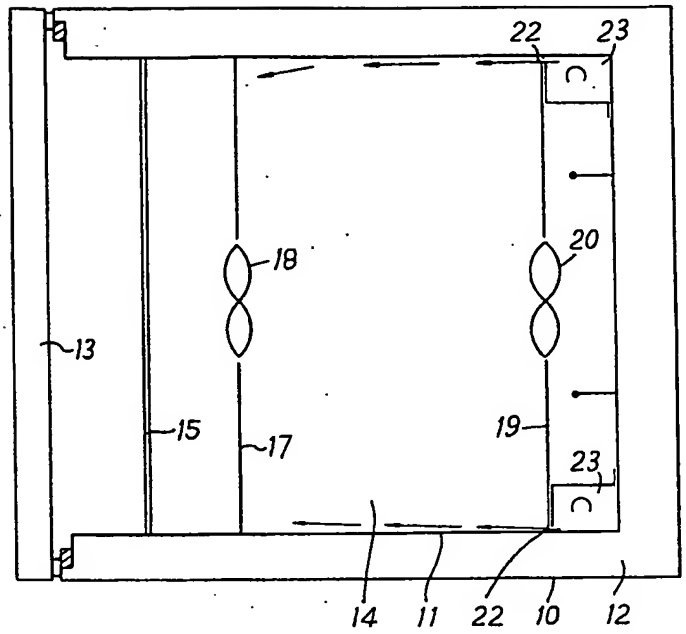

FIG. 3